

Claims:

1. An infrared sensor IC comprising:  
a compound semiconductor sensor, having a compound semiconductor including indium and antimony, and detecting  
5 an infrared radiation by said compound semiconductor to output an electric signal indicating the detection; and  
an integrated circuit processing said electric signal output by said compound semiconductor sensor to perform a predetermined operation,  
10 wherein said compound semiconductor sensor and said integrated circuit are arranged in a single package in a hybrid manner.
2. The infrared sensor IC according to claim 1,  
15 wherein said compound semiconductor sensor comprises  
a substrate;  
a compound semiconductor layer that is formed on said substrate with a buffer layer which is a layer for relaxing a lattice mismatch, the buffer layer being sandwiched  
20 between the compound semiconductor layer and the substrate.
3. The infrared sensor IC according to claim 2,  
wherein said buffer layer is one of AlSb, AlGaSb, AlGaAsSb,  
25 AlInSb, GaInAsSb and AlInAsSb.
4. The infrared sensor IC according to any of claims

1 to 3, wherein said compound semiconductor layer is formed of a single first compound semiconductor layer, and

said first compound semiconductor layer is one of InSb, InAsSb, InSbBi, InAsSbBi, InTlSb, InTlAsSb, InSbN  
5 and InAsSbN.

5. The infrared sensor IC according to claim 4, wherein said first compound semiconductor layer is p-type doped.

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6. The infrared sensor IC according to any of claims 1 to 3, wherein said compound semiconductor layer comprises a second compound semiconductor layer that is a material including indium and antimony; and

15 a third compound semiconductor layer that is formed on said second compound semiconductor layer, so as to be heterojunction with said second compound semiconductor layer, and that is a material that includes antimony and differs from that of said second compound semiconductor  
20 layer.

7. The infrared sensor IC according to claim 6, wherein a combination of said third compound semiconductor layer/said second compound semiconductor layer is one of  
25 GaSb/InSb, GaInSb/InSb, InSb/InAsSb, GaSb/InAsSb and GaInSb/InAsSb.

8. The infrared sensor IC according to claim 6 or 7, wherein both said second compound semiconductor layer and said third compound semiconductor layer, or only said third compound semiconductor layer is p-type doped.

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9. The infrared sensor IC according to any of claims 1 to 3, wherein said compound semiconductor layer comprises a fourth compound semiconductor layer that is a material including at least one of indium or antimony;

10 and

a fifth compound semiconductor layer that is formed on said fourth compound semiconductor layer, so as to be heterojunctional with said fourth compound semiconductor layer, and that is a material including at least one of indium or antimony and differs from that of said fourth compound semiconductor layer, wherein

said fourth compound semiconductor layer and said fifth compound semiconductor layer form a superlattice structure, periodically stacked.

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10. The infrared sensor IC according to claim 9, wherein a combination of said fifth compound semiconductor layer/said fourth compound semiconductor layer is one of InAs/GaSb, InAs/GaInSb, InAs/GaAsSb, InAsSb/GaSb, InAsSb/GaAsSb and InAsSb/GaInSb.

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11. The infrared sensor IC according to any of claims

1 to 3, wherein said compound semiconductor layer is a p-n  
junctional stacked layers comprising a compound  
semiconductor layer which is an n-type doped material  
including indium and antimony, and a compound  
5 semiconductor layer which is a p-type doped material  
including indium and antimony.

12. The infrared sensor IC according to claim 11,  
wherein said stacked layers is a p-n junctional stacked  
10 layers which is one of a p-type doped InSb/an n-type doped  
InSb, a p-type doped InSb/a p-type doped InAsSb/an n-type  
doped InSb, a p-type doped GaInSb/a p-type doped InAsSb/an  
n-type doped GaInSb, and a p-type doped GaInSb/a p-type  
doped InSb/an n-type doped GaInSb.

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13. An infrared sensor comprising:

a substrate; and

a compound semiconductor stacked layers formed on  
said substrate by stacking a plurality of compound  
20 semiconductor layers,

said compound semiconductor stacked layers  
comprising:

a sixth compound semiconductor layer, formed on said  
substrate, that is an n-type doped material including  
25 indium and antimony;

a seventh compound semiconductor layer, formed on  
said sixth compound semiconductor layer, that is a

non-doped or p-type doped material including indium and antimony; and

an eighth compound semiconductor layer, formed on said seventh compound semiconductor layer, that is a  
5 material that is p-doped at a higher carrier density than said seventh compound semiconductor layer and has a larger band gap than said seventh compound semiconductor layer.

14. The infrared sensor according to claim 13,  
10 wherein said sixth compound semiconductor layer is InSb, said seventh compound semiconductor layer is one of InSb, InAsSb and InSbN, and said eighth compound semiconductor layer is either AlInSb or GaInSb, or one of AlAs, InAs, GaAs, AlSb and GaSb, or a mixed crystal of those.

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15. The infrared sensor according to claim 13 or 14, wherein an n-type dopant for said sixth compound semiconductor layer is Sn, and a p-type dopant for said seventh compound semiconductor layer and said eighth  
20 compound semiconductor layer is Zn.

16. The infrared sensor according to any of claims 13 to 15, wherein said compound semiconductor stacked layers further comprises a ninth compound semiconductor  
25 layer, which is formed on said eighth compound semiconductor layer and which is a material including indium and antimony and is p-type doped at a carrier density

equal to or greater than the carrier density of said eighth compound semiconductor layer.

17. The infrared sensor according to claim 16,  
5 wherein said ninth compound semiconductor layer is InSb.

18. The infrared sensor according to claims 16 or 17, wherein a p-type dopant for said ninth compound semiconductor layer is Zn.

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19. The infrared sensor according to any of claims 13 to 18, wherein said substrate is a semi-insulating substrate, or a substrate such that said sixth compound semiconductor layer formed on said substrate can be  
15 insulated from said substrate, the infrared sensor further comprising:

a first electrode that is formed in an area of said sixth compound semiconductor layer where said seventh semiconductor layer is not formed; and

20 a second electrode that is formed in an area on said eighth compound semiconductor layer.

20. The infrared sensor according to claim 19, wherein a plurality of said compound semiconductor stacked  
25 layers are contiguously formed on said substrate, so that a first electrode, formed on a compound semiconductor stacked layers, is connected in series to a second

electrode, formed on a compound semiconductor stacked layers adjacent to said compound semiconductor stacked layers on which said first electrode is formed.

5           21. The infrared sensor according to claims 19 or 20, wherein, when an output signal is measured, a bias between said first and said second electrodes is set to zero, and a signal when an infrared radiation enters is read as an open circuit voltage.

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          22. An infrared sensor IC comprising:  
          an infrared sensor according to claims 13 to 21; and  
          an integrated circuit processing said electric  
signal output by said infrared sensor to perform a  
15 predetermined operation,

          wherein said infrared sensor and said integrated circuit are arranged in a single package in a hybrid manner.

          23. An infrared sensor manufacturing method  
20 comprising the steps of:

          forming, on a substrate, a sixth compound semiconductor layer that is an n-type material including indium and antimony;

          forming, on said sixth compound semiconductor layer,  
25 a seventh compound semiconductor layer that is a non-doped or p-doped material including indium and antimony; and  
          forming, on said seventh compound semiconductor

layer, an eighth compound semiconductor layer that is a material that is p-type doped at a higher carrier density than said seventh compound semiconductor layer and has a larger band gap than said seventh compound semiconductor layer.

24. The infrared sensor manufacturing method according to claim 23, wherein said sixth compound semiconductor layer is InSb, said seventh compound semiconductor layer is one of InSb, InAsSb and InSbN, and said eighth compound semiconductor layer is either AlInSb or GaInSb, or one of AlAs, InAs, GaAs, AlSb and GaSb, or a mixed crystal of those.

25. The infrared sensor manufacturing method according to claims 23 or 24, wherein an n-type dopant for said sixth compound semiconductor layer is Sn, and a p-type dopant for said seventh compound semiconductor layer and said eighth compound semiconductor layer is Zn.

26. The infrared sensor manufacturing method according to any of claims 23 to 25, further comprising a step of forming, on said eighth compound semiconductor layer, a ninth compound semiconductor layer including indium and antimony and is p-type doped at a carrier density equal to or greater than said eighth compound semiconductor layer.



27. The infrared sensor manufacturing method according to claim 26, wherein said ninth compound semiconductor layer is InSb.

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28. The infrared sensor manufacturing method according to claims 26 or 27, wherein a p-type dopant for said ninth compound semiconductor layer is Zn.